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Appendix 3-1

COMPOSITIONS AND CONCENTRATIONS OF COOLING TOWER CHEMICALS

CORROSION AND SCALE INHIBITORS

Commonly used corrosion inhibitors for open recirculating systems include various mixtures of zinc, chromate, phosphate (organic or inorganic), sodium, silicate, nitrate, borate, and organic inhibitors. To prevent scale deposition and to provide effects, organic phosphate compounds such as aminimethylenephosphonate are used in concentrations up to 3 ppm. Mr. R. J. Cunningham, Calgon Corporation, listed the following corrosion and scale-inhibiting chemicals (with their concentrations) in an open letter to Mr. Frank Rainwater of the Environmental Protection Agency:

1.	Chromate plus zinc	5 to 30 mg/l* CrO_4 1 to 15 mg/l Zn
2.	Chromate plus zinc plue phosphate	5 to 30 mg/l CrO_4 1 to 15 mg/l Zn 1 to 5 mg/l PO_4 (inorganic) 1 to 5 mg/l PO_4 (organic)
3.	Zinc plus inorganic phosphate	10 to 30 mg/l PO_4 2 to 10 mg/l Zn
4.	Zinc plus organic phosphate	1 to 10 mg/l Zn 3 to 15 mg/l PO_4 (organic)
5.	Organic phosphate scale inhibitor	1 to 18 mg/l PO_4 (organic)
6.	Specific copper corrosion inhibitors	1 to 5 mg/l sodium mercaptobenzothiazle or benzotriazole

*1 mg/l = 1 ppm

BIOCIDES

Of commonly used biocides, chlorine or hypochlorite (as planned at Palisades) or nonoxidizing organic compounds such as chlorophenols, quaternary amines, and organo-metallics such as organotin compounds, organosulfur, and organothiocyanate (Table 3-1-1) are most frequently employed. They are all used to prevent deterioration of tower wood, loss of heat transfer efficiency, general fouling or plugging arising from microbial growths, and corrosion that results from microbial attack. Organotin must be formulated with quaternary ammonium and other complex amines to produce a synergistic effect and to be dispersible. Chlorophenols, as soluble potassium and sodium salts, are more persistent than free chlorine and remain in systems longer. Common chlorophenols include: 2, 4, 5-trichlorophenate; 2, 4, 6-T; 2, 3, 4, 6-T; tetrachlorophenol; and pentachlorophenol. Organosulfurs are noted for low toxicity to animals, yet effective action against bacteria, fungi, and especially sulfate-reducing bacteria. Quarternary and complex amines are effective wetting agents and destroy microbial agents by surface-active properties; these are the least toxic of all antimicrobial compounds to animals, although they may form and so cause aesthetic problems. The organothiocynates, the most modern of the nonoxidizing biocides, are widely effective. Oils, organic chemicals, water hardness, and other materials seem to cause little reduction in their effectiveness, especially if they are combined with chlorophenols. The nonoxidizing biocides are used whenever the problems are rather severe and where the use of free chlorine is not acceptable. Typical concentrations for continuous use are 1 to 25 ppm; higher (200 ppm or so) if applied in periodic treatments. Elemental chlorine is an oxidizing agent and can cause rapid deterioration of wood. The use of free chlorine as a biocide is usually restricted to 1.0 ppm as free residual Cl_2 and to 1 to hours per day.

The use of biocides that contain mercury, arsenic, lead, or boron is limited by stringent regulations on their

Table 3-1-1

Chemical Composition of Trade Name Micro-Organism Control Chemicals

(From company sources and Environmental Protection Agency)

	Composition (%)	Usage
NALCO 21-S		
Sodium pentachlorophenate	21.3	periodically, as needed
Sodium 2, 4, 5-trichlorophenate	11.9	25-400 ppm
Sodium salts of other Chlorophenols	3.0	or
Inert ingredients	63.8	continuously
NALCO 25-L or NALCO 425-L		
1-Alkyl (C_6 to C_{18})-amino-3-aminopropane propionate-copper acetate complexes	15.0	20-300 ppm
Isopropanol	30.0	
Copper sulfate expressed as metallic copper	0.55	
Inert ingredients	55.0	
NALCO 201		
Potassium pentachlorophenate	15.7	periodically, as needed
Potassium 2, 4, 5-trichlorophenate	9.0	300-400 ppm
Potassium salts of other chlorophenols	1.8	or
Inert ingredients	70.3	12-60 ppm continuously
NALCO 202		
		5-200 ppm periodically
Methyl-1, 2-dibromopropionate	29.7	or
Inert ingredients	70.3	continuously
NALCO 207		weekly
Methylene bisthiocyanate	10.0	25-50 ppm
Inert ingredients	90.0	
NALCO 209		as needed
1, 3-Dichloro-5, 5 dimethyl hydantoin	25.0	50-100 ppm
Inert ingredients	75.5	
NALCO 321		
1-Alkyl (C_6 to C_{18})* amino-3-aminopropane monoacetate	19.8	weekly 10-200 ppm
2, 4, 5-Trichlorophenol	9.5	
Isopropanol	27.0	
Inert ingredients	43.7	

*As in fatty acids of coconut oil

Table 3-1-1 (cont'd)

	Composition (%)	Usage
NALCO 405		
2, 4-Dinitrochlorobenzene	22.2	as needed 100-200 ppm
2, 6-Dinitrochlorobenzene	2.8	
Inert ingredients	75.0	
Betz A-9		
Sodium pentachlorophenate	24.7	
Sodium 2, 4, 5-Trichlorophenate	9.1	
Sodium salts of other chlorophenates	2.9	
Sodium dimethyl dithiocarbamate	4.0	
N-Alkyl (C_{12}-4%, C_{14}-50%, C_{16}-10% dimethyl benzyl ammonium chloride	5.0	
Inert ingredients (including solubilizing and dispersing agents)	54.3	
Betz C-5		
1, 3, Dichloro-5, 5-Dimethylhydantoin	50	
Inert ingredients (including solubilizing and dispersing agents)	50	
Betz C-30		
Bis (trichloromethyl sulfone	20.0	
Methylene disthiocyanate	5.0	
Inert ingredients (including solubilizing and dispersing agents)	75.0	
Betz C-34		
Sodium dimethyl dithiocarbamate	15.0	
Nabam (disodium ethylene bisdithiocarbamate)	15.3	
Inert ingredients (including solubilizing and dispersing agents)	69.7	
Betz J-12		
N-Alkyl (C_{12}-5%, C_{14}-60%, C_{16}-30%, C_{18}-5%) dimethyl benzyl ammonium chloride	24.0	
Bis (tributyltin) oxide	5.0	
Inert ingredients (including solubilizing and dispersing agents)	71.0	
Betz F-14		
Sodium pentachlorophenate	20.0	
2, 4, 5, T or Sodium 2, 4, 5 trichlorophenate	7.5	
Sodium salts of chlorophenate	2.5	
Dehydrobutyl ammonium phenoxide	2.0	
Inert ingredients, including dispersants	68.0	

release to the environment than do most of the compounds previously discussed, because of their extreme toxicity. These are rarely if ever used now; however, a review of label names in Table 3-1-1 reveals that the potentially toxic materials, copper and thiocyanate ions, are present in some commercial compounds. Tin is probably also questionable as far as toxicity is concerned. All of the chemical labels note that precautions should be used in handling of the product, and two indicate that the product may be harmful or fatal if absorbed through the skin. Only two, however, cautioned against dumping them directly into lakes, streams, or ponds. Some of the products containing 2, 4, 5-T listed no such precautions; yet the compound is not expressly banned in waterways.

pH ADJUSTORS AND SILT CONTROL (ANTIFOULANT) POLYMERS

Scale and corrosion inhibitors and biocides require the addition of acid or alkali to makeup water to keep the pH at an optimum level, usually a range from 5.5 to 7.5. Silt controls polymers may be used if makeup is raw water from a nearby lake or river. Lignin-tannin dispersives such as 1 to 50 ppm sodium lignosulfonate may be employed. Antifoulants such as 0.1 to 5 ppm of acrylamids, polyacrylate, polyethyleneimine, or other high molecular synthetic organic polyelectrolytes may also be used.

Appendix 3-2

PHYSICAL AND CHEMICAL DATA FROM THE PATAPSCO RIVER ESTUARY, MARYLAND

The following pages include reproductions of the original data sheets furnished with respect to the Patapsco River Estuary, and figures showing temperature, salinity, and dissolved oxygen content in the Patapsco River Estuary.

ANALYSIS OF WATER

#2

CLIENT Baltimore Gas & Elec. Co., #1821 Date

Baltimore Harbor water- From 1 foot depth, Buoy #13 S Black can

Date taken Received Lab. No. 266934

Description of Sample 3/22/72 1030 hrs.

Constituents - p.p.m. As		
Calcium	Ca	66.56
Magnesium	Mg	138.17
Sodium & Potassium	Na By diff.	1230.0
Chloride	Cl	2150.8
Sulphate	SO_4	314.8
Nitrate	NO_3	1.10
Phosphate Total	PO_4	1.90
Bicarbonate	HCO_3	53.68
Carbonate	CO_3	
Hydroxide	OH	
Silica	SiO_2	5.20
Iron Total	Fe	.15
Manganese	Mn	.02
Sum		
Total Residue		3920
Suspended Matter		5
Volatile Residue		210
Turbidity		
Color		
Cal. ~~total hardness~~ Hardness as	$CaCO_3$	735
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	44.0
pH 6.90		

3-2-2

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

ANALYSIS OF WATER

CLIENT Baltimore Gas & Elec. Co. #1821 Date #3

Harbor Water- Red buoy #4- Surface 3/22/72 1100 hrs

Date taken _____ Received _____ Lab. No. 266931

Description of Sample _____

Constituents - p.p.m. As		
Calcium	Ca	58.30
Magnesium	Mg	133.50
Sodium & Potassium	Na	By diff. 1091.8
Chloride	Cl	1914.8
Sulphate	SO_4	307.8
Nitrate	NO_3	1.17
Phosphate Total	PO_4	1.85
Bicarbonate	HCO_3	53.68
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.40
Iron Total	Fe	.14
Manganese	Mn	.02
Sum		
Total Residue		3700
Suspended Matter		6
Volatile Residue		190
Turbidity		
Color		
Cal. total hardness Hardness as	$CaCO_3$	695
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	44.0
pH		6.05

3-2-3

SHEPPARD T. POWELL AND ASSOCIATES
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ANALYSIS OF WATER

#4

CLIENT Baltimore Gas & Elec. Co., #1821 Date

Baltimore Harbor water- Red buoy #2- Surface, 3/22/72 1120 hrs.

Date taken Received Lab. No. 266935

Description of Sample

Constituents - p.p.m.	As	
Calcium	Ca	72.80
Magnesium	Mg	133.20
Sodium & Potassium	Na By diff.	1144.0
Chloride	Cl	2030.5
Sulphate	SO_4	294.2
Nitrate	NO_3	1.15
Phosphate Total	PO_4	1.87
Bicarbonate	HCO_3	52.46
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.40
Iron Total	Fe	.14
Manganese	Mn	.03
Sum		
Total Residue		3760
Suspended Matter		7
Volatile Residue		190
Turbidity		
Color		
~~Cal. tot I hardness~~		
Hardness as	$CaCO_3$	730
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	43.0
pH 6.95		

3-2-4

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

ANALYSIS OF WATER

CLIENT Baltimore Gas & Elec. Co., #1821 Date #5

Baltimore Harbor water- Sparrows Point- Surface, 3/22/72 1130 hrs.

Date taken _____ Received _____ Lab. No. _____

Description of Sample _____

Constituents - p.p.m. As		
Calcium	Ca	37.45
Magnesium	Mg	79.30
Sodium & Potassium	Na	By diff. 603.9
Chloride	Cl	1063.8
Sulphate	SO_4	186.0
Nitrate	NO_3	1.20
Phosphate Total	PO_4	2.40
Bicarbonate	HCO_3	41.48
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.70
Iron Total	Fe	2.25 Iron(Dissolved) Fe- .12
Manganese Total	Mn	.05
Sum		
Total Residue Dissolved solids		2280
Suspended Matter		28
Volatile Residue		120
Turbidity		
Color		
Hardness Cal. total hardness as	$CaCO_3$	420
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	34.0
pH 7.00		

3-2-5

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

ANALYSIS OF WATER

CLIENT Baltimore Gas & Elec. Co., #1821 Date #6

Harbor water- Wagner Station Sta. 1- Surface, 3/22/72 1200 hrs.

Date taken _____ Received _____ Lab. No. 266932

Description of Sample _____

Constituents - p.p.m.	As	
Calcium	Ca	58.25
Magnesium	Mg	132.30
Sodium & Potassium	Na	By diff. 1120.5
Chloride	Cl	1950.3
Sulphate	SO_4	313.9
Nitrate	NO_3	1.10
Phosphate Total	PO_4	1.83
Bicarbonate	HCO_3	54.00
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.50
Iron Total	Fe	.13
Manganese	Mn	.02
Sum		
Total Residue		3720
Suspended Matter		4
Volatile Residue		180
Turbidity		
Color ~~total hardness~~		
Hardness as	$CaCO_3$	690
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	45.0
pH 7.00		

3-2-6

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

ANALYSIS OF WATER

CLIENT Baltimore Gas & Elec. Co., #1821 Date #7

Harbor water- Warner 3/24/72 0915 hrs.

Date taken _____ Received _____ Lab. No. _____

Description of Sample STATION FL"8"

Constituents - p.p.m.	As	
Calcium	Ca	66.56
Magnesium	Mg	150.32
Sodium & Potassium	Na	By diff. 1263.3
Chloride	Cl	2198.5
Sulphate	SO_4	388.8
Nitrate	NO_3	1.15
Phosphate Total	PO_4	1.95
Bicarbonate	HCO_3	26.84
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.40
Iron Total	Fe	4.10 Iron(Dissolved) Fe- .15
Manganese Total	Mn	.08
Sum		
Total Residue Dissolved solids		4360
Suspended Matter		45
Volatile Residue		180
Turbidity		
Color		
Hardness Cal. total hardness as	$CaCO_3$	785
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	22.0
pH 6.20		

3-2-7

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

ANALYSIS OF WATER

CLIENT Baltimore Gas & Elec. Co., #1821 Date #8

Harbor water- Warner- Buoy 11S- Surface, 3/24/72 1000 hrs.

Date taken _____ Received _____ Lab. No. 266033

Description of Sample _____

Constituents - p.p.m. As		
Calcium	Ca	84.15
Magnesium	Mg	149.90
Sodium & Potassium	Na By diff.	1383.0
Chloride	Cl	2420.0
Sulphate	SO_4	358.0
Nitrate	NO_3	1.12
Phosphate Total	PO_4	1.80
Bicarbonate	HCO_3	54.90
Carbonate	CO_3	.00
Hydroxide	OH	
Silica	SiO_2	5.50
Iron	Fe	.03
Manganese	Mn	
Sum		
Total Residue		4500
Suspended Matter		4
Volatile Residue		220
Turbidity		
Color		
Cal. total hardness Hardness as	$CaCO_3$	*27
P. Alkalinity	$CaCO_3$	.0
M. Alkalinity	$CaCO_3$	45.0
pH 7.00		

3-2-8

SHEPPARD T. POWELL AND ASSOCIATES
CONSULTING ENGINEERS

STRASBURGER & SIEGEL, INC.

CHEMISTS AND FOOD TECHNOLOGISTS

BACTERIOLOGISTS

1403 EUTAW PLACE BALTIMORE, MARYLAND 21217

Tel: 523-5518 - 5519

April 10, 1972

CERTIFICATE OF ANALYSIS

(A. O. A. C. AND A. P. H. A. METHODS)

Laboratory No. 20585

Sample of 7 samples, Harbor Water, 1 qt alkali fixed, 1 qt. acid fixed

Received from Sheppard T. Powell, Inc. Baltimore, Maryland

Marked Rec'd 4/4/72

REPORT

				PPM, CYANIDE AS Cn	PPM, C.O.D.
#1	Sparrows Point	3/22/72	11:30 AM	0.39	25.0
#2	Wagner Station #1	3/22/72	12:00 NOON	0.33	71.2
#3	Red Buoy #2	3/22/72	11:20 AM	0.53	211.1
#4	Red Buoy #4	3/22/72	11:00 AM	0.20	201.9
#5	Buoy #135 - Block Can	3/22/72	10:30 AM	0.39	84.6
#6	Wagner FL'8"	3/24/72	9:15 AM	0.20	128.9
#7	Wagner - Buoy #115	3/24/72	10:00 AM	0.39	117.3

3-2-9

STRASBURGER & SIEGEL, Inc.

Strasburger & Siegel

ANALYSTS

Sheppard T. Powell Associates
B.G. & E. Co., Wagner
Samples received March 24, 1972

Identification	3/24/72 0915 FL"8"	3/24/72 1000 C"11S"
Kjeldahl-N (mg/l)	2.38	1.33
NH_3-N (mg/l)	1.58	0.79
Organic-N (mg/l)	0.80	0.54
NO_3-N (mg/l)	0.92	0.96
NO_2-N (mg/l)	0.02	0.02
PO_4-P (mg/l)	0.016	0.089

Sample	Identification		
1	3/22/72	1045	B.G.& E., Wagner, Buoy 13S, Surface
2	3/22/72	1045	B.G.& E., Wagner, Buoy 13S, Bottom
3	3/22/72	1100	B.G.& E., Wagner, Red Buoy 4, Surface
4	3/22/72	1055	B.G.& E., Wagner, Red Buoy 4, Bottom
5	3/22/72	1120	B.G.& E., Wagner, Red Buoy 2, Surface
6	3/22/72	1120	B.G.& E., Wagner, Red Buoy 2, Bottom
7	3/22/72	1130	B.G.& E., Wagner, Sparrows Pt., Surface
8	3/22/72	1130	B.G.& E., Wagner, Sparrows Pt., Bottom
9	3/22/72	1200	B.G.& E., Wagner, Sta. #1, Surface
10	3/24/72	0915	#1 Bay
11	3/24/72	1000	#2 Harbor Water

Sample	Inorganic Carbon (mg/l)	Total Organic Carbon (mg/l)
1	10	8
2	11	6
3	10	6
4	14	7
5	10	17
6	11	15
7	9	7
8	8	7
9	9	6
10	7	7
11	10	7

J. Charles Baummer, Jr.

Analysis of Samples Submitted March 22, 1972

B.G. &.E., Wagner, collected 3/22/72

Sample	Identification
1	Buoy 13S, surface, 1045
2	Buoy 13S, bottom, 1045
3	Red buoy 4, surface, 1100
4	Red buoy 4, bottom, 1055
5	Red buoy 2, surface, 1120
6	Red buoy 2, bottom, 1120
7	Sparrows Point, surface 1130
8	Sparrows Point, bottom, 1130
9	Sta #1, surface, 1200

Sample	Kjeldahl-N (mg/l)	NH_3-N (mg/l)	Organic-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	PO_4-P (mg/l)
1	1.55	0.80	0.75	0.02	0.97	0.013
2	1.35	0.77	0.58	0.02	0.98	0.016
3	1.40	0.79	0.61	0.02	1.01	0.010
4	1.30	0.73	0.57	0.02	0.83	0.018
5	1.21	0.65	0.56	0.02	1.00	0.010
6	1.84	0.80	1.04	0.02	0.96	0.023
7	1.12	0.40	0.72	0.02	0.98	0.030
8	1.92	0.69	1.23	0.02	0.96	0.014
9	1.35	0.70	0.65	0.02	1.04	0.011

Identification of Samples

Sample	Source		
26	4/5/72	0945	Bush Point
27	4/5/72	1015	Wilson Point
28	4/5/72	1035	Chilbury
29	4/5/72	1100	B.G.&E., West Side of Power Lines
30	4/5/72	1115	B.G.& E., East Side of Power Lines
31	4/5/72	1135	B.G.& E., Church Creek
32	4/5/72	1220	B.G.& E., Otter Creek
33	4/5/72		B.G.& E., Red Buoy 8
34	4/6/72	0700	B.G.& E., Romney Creek
35	4/6/72	0740	Buoy 38
36	4/6/72	0755	B.G.& E., Bush River Buoys 3-4
37	4/6/72	0820	Lego Point
38	4/6/72	0850	B.G.& E., Bush River South Station #1
39	4/6/72	0930	B.G.& E., Bush River, North Side of Bridge
40	4/6/72	0955	B.G.& E., Church Creek
41	4/11/72	1025	B.G.& E., Brandon Shores, Sta. CM 4B, Surface
42	4/11/72	1100	B.G.& E., Brandon Shores, Sta. off Rock Point Surface
43	4/11/72	1130	B.G.& E., Brandon Shores, Sta. Buoy #2, Surface
44	4/11/72	1155	B.G.& E., Brandon Shores, Buoy 4M, Surface
45	4/11/72	1240	B.G.& E., Brandon Shores, Buoy 12M, Surface
46	4/11/72	1300	B.G.& E., Brandon Shores, Buoy 11M, Surface
47	4/11/72	1425	B.G.& E., Brandon Shores, Sta. #1, Surface

Sample	NO_2-N (mg/l)	NO_3-N (mg/l)	Kjeldahl-N (mg/l)	NH_3-N (mg/l)	Organic-N (mg/l)	PO_4-P (mg/l)
26	0.01	1.09	1.02	0.15	0.87	0.012
27	0.01	1.03	0.72	0.10	0.62	0.007
28	0.01	1.10	0.73	0.12	0.61	0.016
29	0.01	1.18	1.81	0.20	1.61	0.021
30	0.01	1.32	0.86	0.09	0.77	0.011
31	0.02	1.28	1.32	0.16	1.16	0.012
32	0.02	1.59	1.11	0.15	0.96	0.011
33	0.01	1.14	1.21	0.16	1.05	0.008
34	0.01	0.99	1.16	0.18	0.98	0.013
35	0.01	1.03	0.55	0.08	0.47	0.008
36	0.01	1.03	0.75	0.17	0.58	0.012
37	0.01	1.05	1.22	0.18	1.04	0.010
38	0.01	1.14	1.03	0.16	0.87	0.016
39	0.02	1.28	1.40	0.16	1.24	0.012
40	0.02	1.31	1.08	0.14	0.94	0.017
41	0.02	0.94	0.80	0.26	0.54	0.020
42	0.02	0.92	0.91	0.55	0.36	0.022
43	0.02	0.89	1.24	0.60	0.64	0.011
44	0.02	0.89	1.36	0.74	0.62	0.030
45	0.02	0.84	1.56	0.78	0.78	0.012
46	0.02	0.84	1.64	1.00	0.64	0.010
47	0.02	0.82	1.95	0.99	0.96	0.009

J. Charles Baummer, Jr.

Sample	Inorganic Carbon (mg/l)	Total Organic Carbon (mg/l)
26	7	7
27	7	7
28	6	7
29	6	11
30	5	8
31	6	9
32	5	7
33	7	8
34	6	7
35	7	6
36	6	7
37	6	8
38	6	8
39	5	8
40	5	8
41	8	10
42	9	16
43	10	8
44	11	11
45	11	10
46	11	14
47	11	9

J. Charles Baumer, Jr

Sheppard T. Powell Associates
Samples Collected 6/26/72
Brandon Snores

Sample	Identification		
79	#26	0900	sur.
80	#26	0900	bot.
81	#25	0945	sur.
82	#25	0945	m.d.
83	#25	0945	bot.
84	#21	1025	sur.
85	#21	1025	m.d.
86	#21	1025	bot.
87	#20	1100	sur.
88	#20	1100	m.d.
89	#20	1100	bot.
90	#24	1145	sur
91	#24	1145	m.d.
92	#24	1145	bot.
93	#30	1330	sur.
94	#30	1330	m.d.
95	#30	1330	bot.
96	#31	1400	sur.
97	#31	1400	m.d.
98	#31	1400	bot.
99	#27		bot
100	#27		sur.

Sheppard T. Powell Associates
Samples Collected 6/26/72

Sample	Kjeldahl-N (mg/l)	NH_3-N (mg/l)	Organic-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	PO_4-P (mg/l)
79	1.51	0.83	0.68	0.06	0.90	0.037
80	1.55	0.89	0.66	0.04	0.75	0.023
81	1.30	0.52	0.78	0.06	0.76	0.026
82	1.51	0.76	0.75	0.04	0.92	0.021
83	2.02	1.12	0.90	0.04	0.66	0.015
84	1.28	0.62	0.66	0.04	1.08	0.027
85	1.42	0.81	0.61	0.04	0.91	0.023
86	1.73	1.07	0.66	0.04	0.66	0.028
87	1.34	0.69	0.65	0.03	1.07	0.023
88	1.40	0.81	0.59	0.03	0.84	0.022
89	1.62	1.03	0.59	0.04	0.61	0.014
90	1.62	0.83	0.79	0.04	0.98	0.013
91	1.47	0.85	0.62	0.04	0.86	0.012
92	2.55	1.78	0.77	0.06	0.59	0.012
93	1.55	0.75	0.80	0.06	0.87	0.047
94	1.75	0.59	1.16	0.06	0.82	0.058
95	1.66	1.00	0.66	0.05	0.59	0.009
96	1.22	0.64	0.58	0.05	0.72	0.016
97	1.30	0.65	0.65	0.05	0.71	0.023
98	1.14	0.63	0.51	0.05	0.68	0.019
99	1.34	0.82	0.52	0.05	0.76	0.025
100	1.29	0.78	0.51	0.05	0.88	0.024

J. Charles Baummer, Jr.

Sheppard T. Powell Associates
Samples Collected 6/26/72

Sample	Total Organic Carbon (mg/l)	Inorganic Carbon (mg/l)
79	7	10
80	7	10
81	5	9
82	6	9
83	8	10
84	6	9
85	6	10
86	8	10
87	7	9
88	5	10
89	6	10
90	6	9
91	8	9
92	9	12
93	9	7
94	8	7
95	8	9
96	6	9
97	6	9
98	6	9
99	5	10
100	5	8

J. Charles Baummer, Jr.

STRASBURGER & SIEGEL, INC.

CHEMISTS AND FOOD TECHNOLOGISTS

BACTERIOLOGISTS

1403 EUTAW PLACE BALTIMORE, MARYLAND 21217

Tel: 523-5518 - 5519

June 30, 1972

CERTIFICATE OF ANALYSIS

(A. O. A. C. AND A. P. H. A. METHODS)

Laboratory No. 21349

Sample of 22 samples of Waste Water

Received from Sheppard T. Powell & Associates, Baltimore, Md.

Marked B. G. & E. Co., Brandon Shores 6-26-72

Rec. 6-27-72

REPORT

	Cyanide Content as CN in ppm
Station #20 - Surface	0.13
#20 - Mid Depth	0.40
#20 - Bottom	0.46
#21 - Surface	0.66
#21 - Mid Depth	0.33
#21 - Bottom	0.27
#24 - Surface	0.13
#24 - Mid Depth	0.27
#24 - Bottom	0.27
#25 - Surface - Tide ebbing	0.53
#25 - Mid Depth - Tide ebbing	0.13
#25 - Bottom - Tide ebbing	0.13
#26 - Surface - Tide ebbing - 0900 hrs.	0.07
#26 - Bottom - Tide ebbing - 0900 hrs.	0.27
#27 - Surface - Tide ebbing - 0830 hrs.	0.13
#27 - Bottom - Tide ebbing - 0830 hrs.	0.27
#30 - Surface	0.20
#30 - Mid Depth	0.27
#30 - Bottom	0.13
#31 - Surface	0.13
#31 - Mid Depth	0.13
#31 - Bottom	0.13

STRASBURGER & SIEGEL, Inc.

Strasburger & Siegel Inc

ANALYSTS

Sheppard T. Powell Associates
Samples Received May 19, 1972

Sample	Identification
53	B.S., 5/17/72, 0917, #1, mid-depth, 7.5 ft
54	B.S., 5/17/72, 0937, #3, mid-depth, 5.5 ft
55	B.S., 5/17/72, 1037, 11M, surface
56	B.G. & E. Co., Brandon Shores, 5/17/72, 1050, Buoy 11M mid-depth, 12 ft, tide flooding
57	B.G. & E. Co., Brandon Shores, 5/17/72, 1050, Buoy 11M bottom, 24 ft, tide flooding
58	B.G. & E. Co., Brandon Shores, 5/17/72, 1115, Buoy 12M surface, tide flooding
59	B.G. & E. Co., Brandon Shores, 5/17/72, 1115, Buoy 12M mid-depth, 17 ft, tide flooding
60	B.G. & E. Co., Brandon Shores, 5/17/72, 1115, Buoy 12M bottom, 34 ft, tide flooding
61	B.G. & E.,Co., Brandon Shores, 5/17/72, 1140, Buoy 4M surface, tide ebbing
62	B.G. & E. Co., Brandon Shores, 5/17/72, 1140, Buoy 4M mid-depth, 15 ft, tide ebbing
63	B.G. & E. Co., Brandon Shores, 5/17/72, 1140, Buoy 4M bottom, 30 ft, tide ebbing
64	B.G. & E. Co., Brandon Shores, 5/17/72, 1200, Buoy 2 surface, tide ebbing
65	B.G. & E. Co., Brandon Shores, 5/17/72, 1200, Buoy 2 mid-depth, 8.5 ft, tide ebbing
66	B.G. & E. Co., Brandon Shores, 5/17/72, 1200, Buoy 2 bottom, 17 ft, tide ebbing
67	B.G. & E. Co., Brandon Shores, 5/17/72, 1240, Buoy 4B surface, tide ebbing
68	B.G. & E. Co., Brandon Shores, 5/17/72, 1240, Buoy 4B mid-depth, 14.5 ft, tide ebbing
69	B.G. & E. Co., Brandon Shores, 5/17/72, 1240, Buoy 4B Bottom, 29 ft

Sample	Identification
70	B.G. & E. Co., Brandon Shores, 5/17/72, 1305, Rocky Point Surface, tide ebbing
71	B.G. & E., Co., Brandon Shores, 5/17/72, 1305, Rocky Point mid-depth, 3.5 ft., tide ebbing
72	B.G. & E. Co., Brandon Shores, 5/17/72, 1305, Rocky Point bottom, 7 ft, tide ebbing
73	Bush River, 5/18/72, 1215, Sta B, mid-depth, 4 ft Tide flooding

Sample	Kjeldahl-N (mg/l)	NH_3-N (mg/l)	Organic-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	PO_4-P (mg/l)
53	1.39	0.50	0.89	0.03	0.73	0.038
54	1.53	0.54	0.99	0.03	0.72	0.045
55	1.82	0.59	1.23	0.03	0.73	0.007
56	1.80	0.69	1.11	0.03	0.73	0.007
57	2.30	0.85	1.45	0.03	0.67	0.020
58	1.63	0.56	1.07	0.03	0.72	0.006
59	1.75	0.75	1.00	0.03	0.71	0.007
60	1.58	0.80	0.78	0.03	0.62	0.013
61	1.64	0.58	1.06	0.02	0.70	0.008
62	1.88	0.66	1.22	0.03	0.71	0.004
63	1.41	0.80	0.61	0.03	0.64	0.008
64	1.25	0.32	0.93	0.02	0.69	0.006
65	1.31	0.51	0.80	0.02	0.72	0.006
66	1.70	0.72	0.98	0.03	0.63	0.012
67	0.78	0.15	0.63	0.01	0.67	0.009
68	0.77	0.46	0.31	0.02	0.73	0.006
69	1.39	0.81	0.58	0.03	0.65	0.016
70	1.07	0.20	0.87	0.02	0.72	0.007
71	0.97	0.21	0.76	0.02	0.72	0.006
72	0.99	0.2.	0.72	0.02	0.73	0.008
73	1.03	0.16	0.87	0.01	0.36	0.006

J. Charles Baummer, Jr.

Sample	Total Organic Carbon (mg/l)	Inorganic Carbon (mg/l)
53	4	10
54	5	9
55	8	9
56	7	10
57	7	12
58	6	8
59	7	10
60	6	12
61	5	9
62	6	10
63	7	12
64	17	8
65	8	8
66	18	9
67	5	7
68	5	9
69	5	12
70	5	7
71	6	7
72	5	8
73	7	7

J Charles Baummer, Jr.

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
SILVER SPRING MARYLAND

PATAPSCO RIVER
NUTRIENT ASSAY OF FILTERED WATER SAMPLES COLLECTED
DURING PHYTOPLANKTON SAMPLING AT THE PATAPSCO ESTUARY
ON 22 AUGUST, 1972.

Collection Station

Species	21	25	26	31	34	37
Inorganic Carbon	13.0	10.4	13.3	12.2	9.1	10.5
Nitrate - Nitrogen	0.51	0.49	0.48	0.49	0.49	0.56
Nitrite - Nitrogen	0.060	0.044	0.067	0.049	0.041	0.057
Ammonia - Nitrogen	0.42	0.45	0.71	0.61	0.38	2.06
Orthophosphate - Phosphorous	0.021	0.010	0.012	0.009	0.010	0.022
Kjeldahl - Nitrogen (Total unoxidized Nitrogen)	0.84	0.67	0.99	1.09	0.64	2.48
Kjeldahl - Phosphorous (Total Phosphorous)	0.050	0.024	0.046	0.024	0.026	0.048
Organic Nitrogen	0.43	0.22	0.28	0.48	0.26	0.42
Non-orthophosphate-Phosphorous	0.029	0.014	0.034	0.015	0.016	0.026

(All concentrations in parts per million mg/l of the element)

Analyzed by Michael M. Robison, Department of Geography and Environmental Engineering,

The Johns Hopkins University

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
SILVER SPRING MARYLAND

PATAPSCO RIVER

NUTRIENT ASSAY OF FILTERED WATER SAMPLES COLLECTED
DURING PHYTOPLANKTON SAMPLING AT THE PATAPSCO ESTUARY
ON 28 JUNE, 1972.

Collection Station

Species	21	25	26	31	34	37
Inorganic Carbon	7.0	7.5	7.5	7.5	7.0	7.5
Nitrate - Nitrogen	0.70	0.77	0.69	0.73	0.72	0.69
Nitrite - Nitrogen	0.046	0.041	0.043	0.041	0.043	0.058
Ammonia - Nitrogen	0.59	0.78	0.56	0.55	0.47	1.31
Orthophosphate - Phosphorous	0.044	<0.001	0.018	0.027	0.038	0.046
Kjeldahl - Nitrogen (Total Unoxidized Nitrogen)	0.92	1.30	0.92	0.86	0.86	1.68
Kjeldahl - Phosphorous (Total Phosphorous)	0.069	0.014	0.037	0.017	0.068	0.078
Organic Nitrogen	0.33	0.52	0.36	0.31	0.39	0.37
Non-orthophosphate-Phosphorous	0.025	0.014	0.019	0.044	0.030	0.032

All concentrations in parts per million mg/l of the element)

Analyzed by Michael M. Robison, Department of Geography and Environmental Engineering,

The Johns Hopkins University

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
SILVER SPRING MARYLAND

PATAPSCO RIVER

NUTRIENT ASSAY OF FILTERED WATER SAMPLES COLLECTED
DURING PHYTOPLANKTON SAMPLING AT THE PATAPSCO ESTUARY
ON 1 AUGUST, 1972.

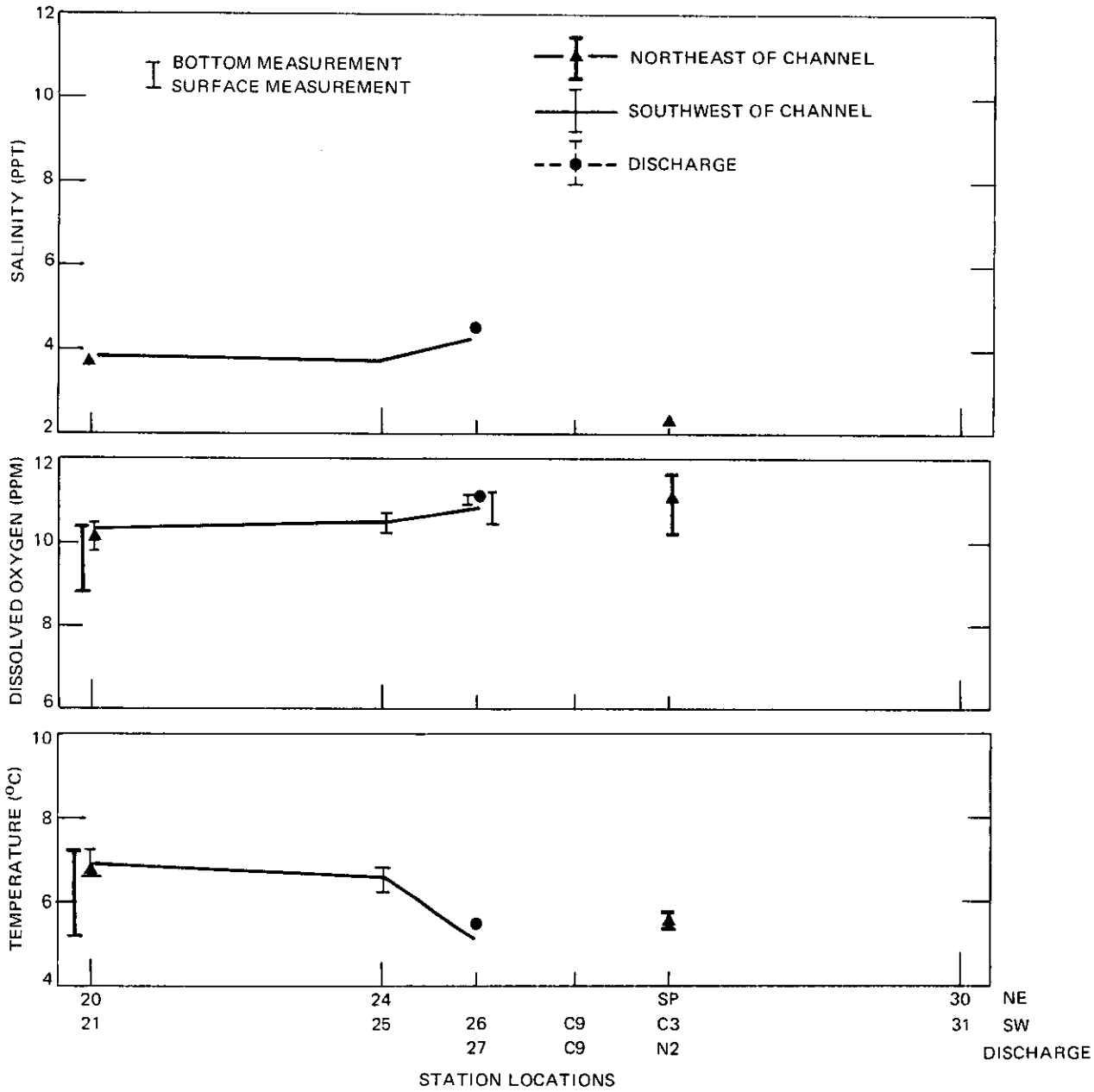
Collection Station

Species	21	25	26	31	34	37
Inorganic Carbon	11.3	10.6	10.5	9.0	9.4	9.9
Nitrate - Nitrogen	0.59	0.64	0.62	0.67	0.66	0.68
Nitrite - Nitrogen	0.20	0.16	0.17	0.11	0.11	0.13
Ammonia - Nitrogen	0.38	0.93	0.77	0.34	0.53	2.25
Orthophosphate - Phosphorous	0.004	0.002	0.017	0.001	<0.001	0.005
Kjeldahl - Nitrogen (Total unoxidized Nitrogen)	0.72	1.34	1.09	0.41	0.86	2.80
Kjeldahl - Phosphorous (Total Phosphorous)	0.027	0.017	0.035	0.007	0.012	0.036
Organic Nitrogen	0.34	0.41	0.32	0.07	0.33	0.55
Non-orthophosphate-Phosphorous	0.022	0.015	0.028	0.006	0.012	0.031

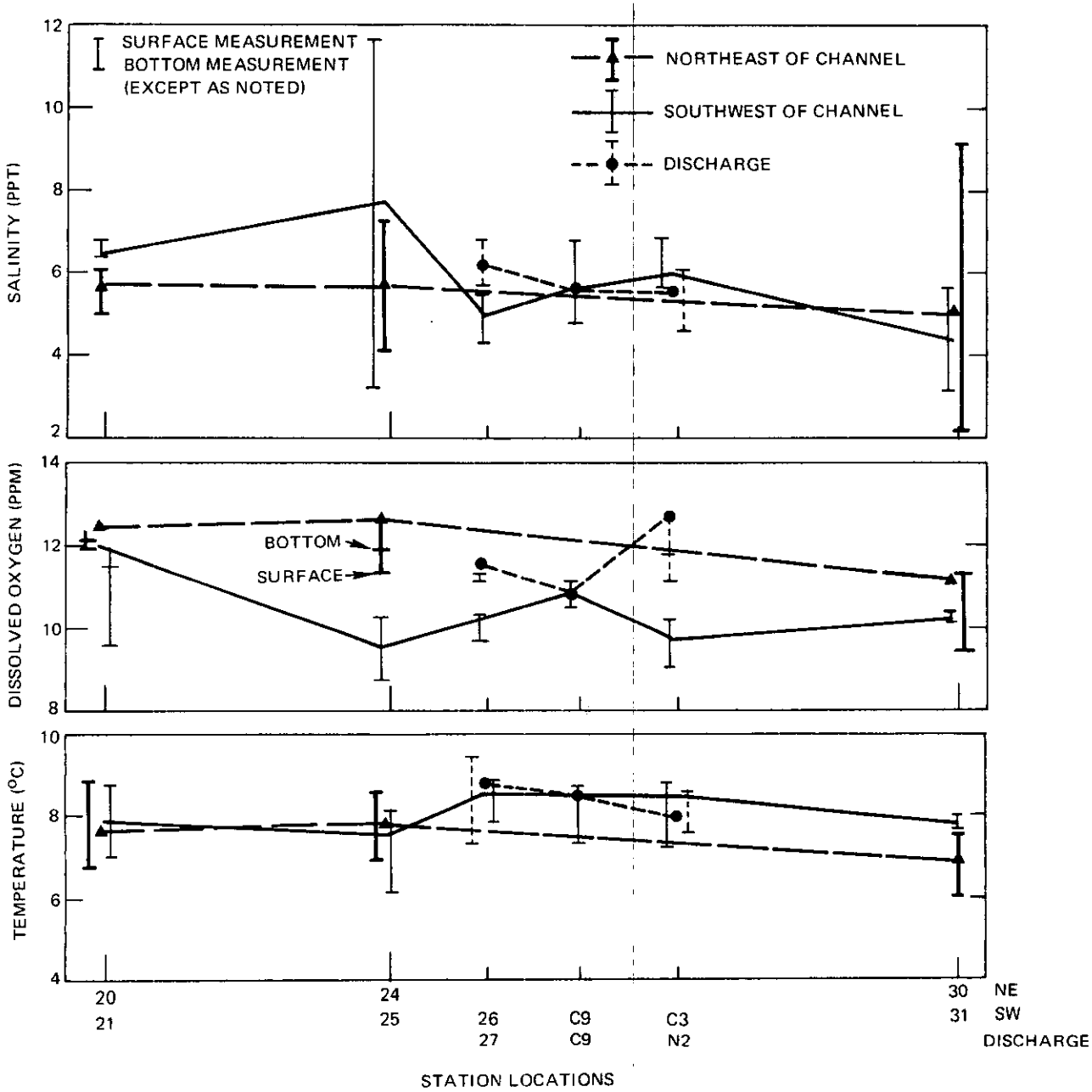
(All concentrations in parts per million mg/l of the element)

Analyzed by Michael M. Robison, Department of Geography and Environmental Engineering,

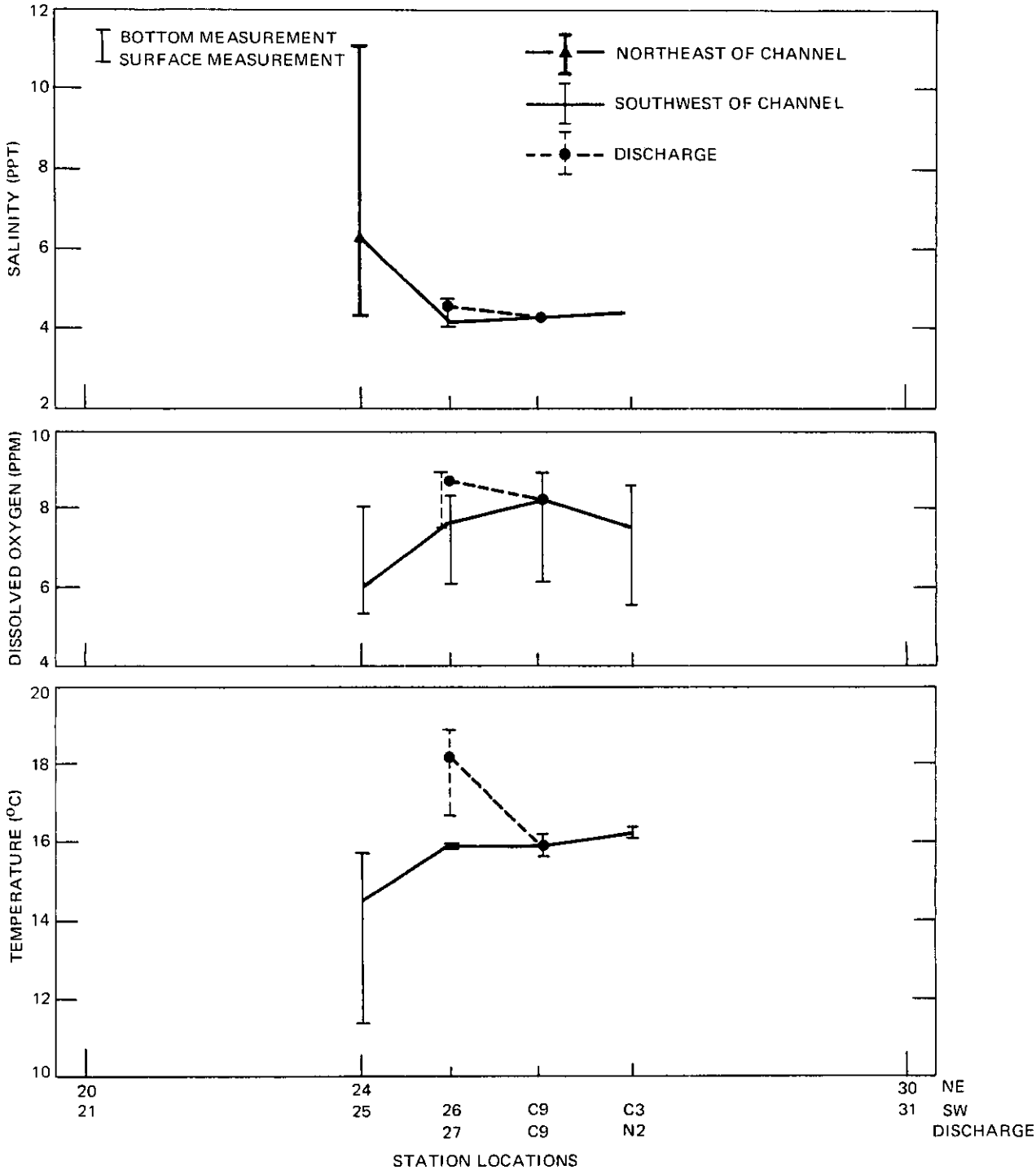
The Johns Hopkins University



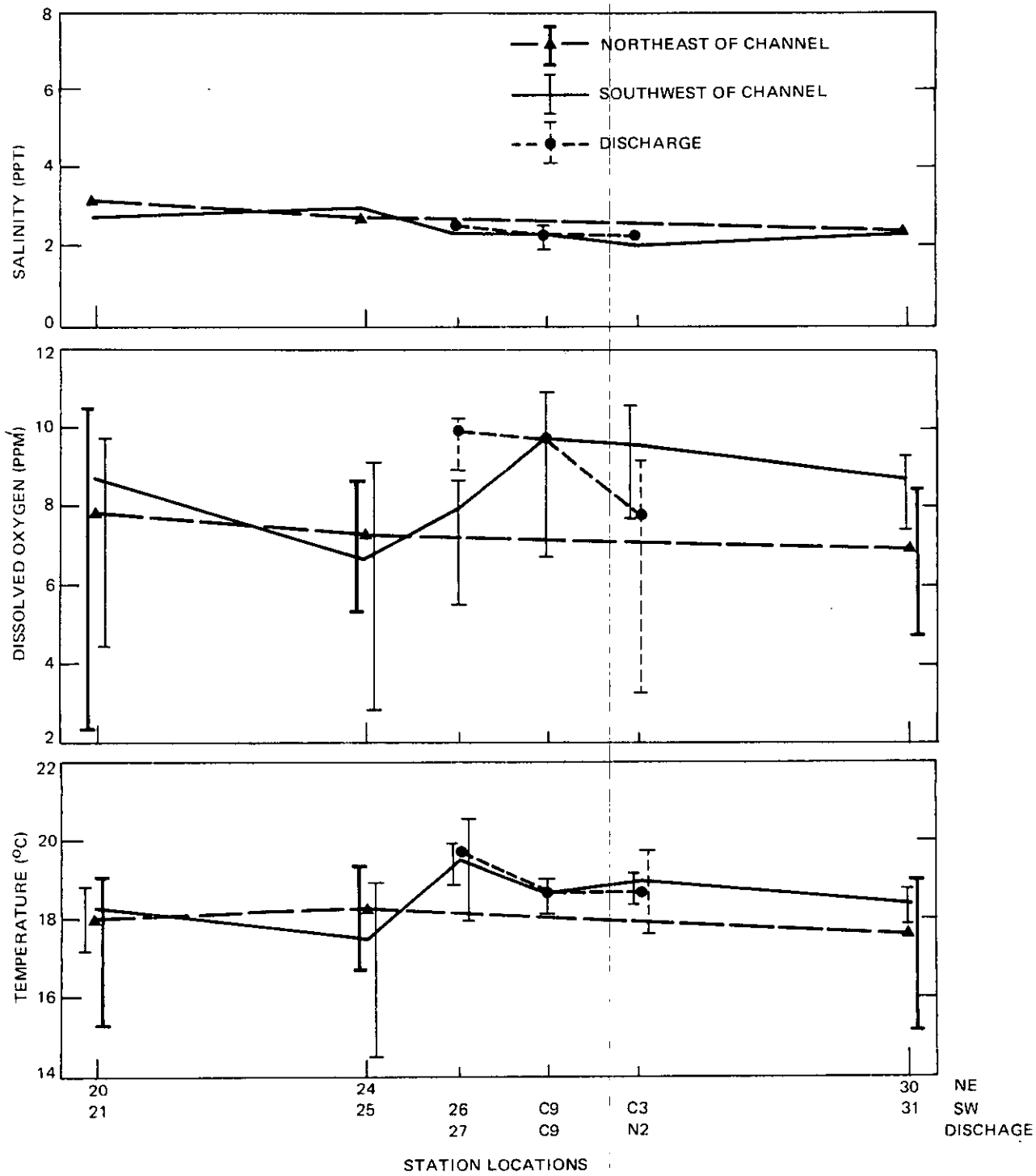
APPENDIX 3-2 Figure 1 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 22 MARCH 1972.



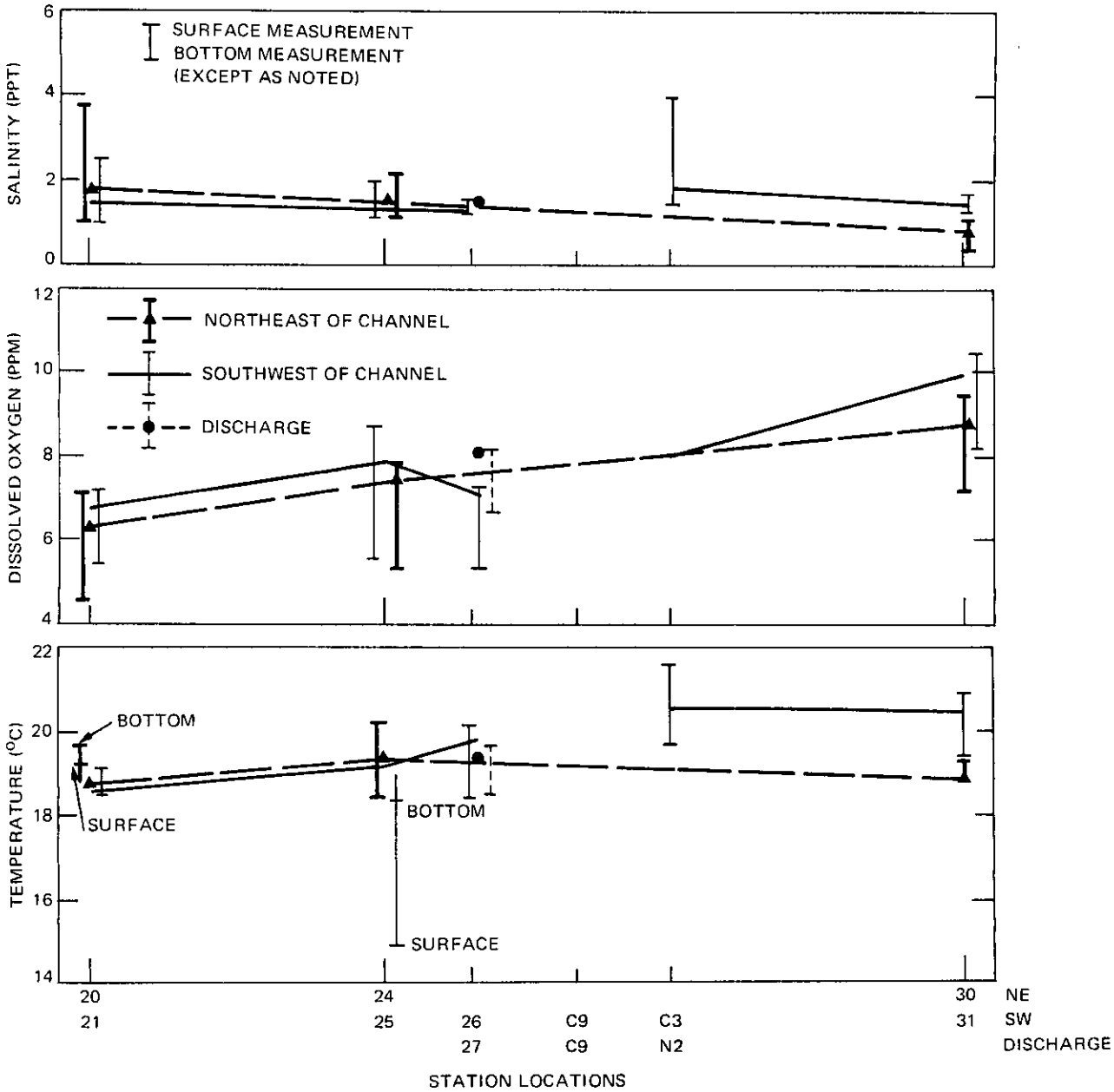
APPENDIX 3-2 Figure 2 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 11 APRIL 1972.



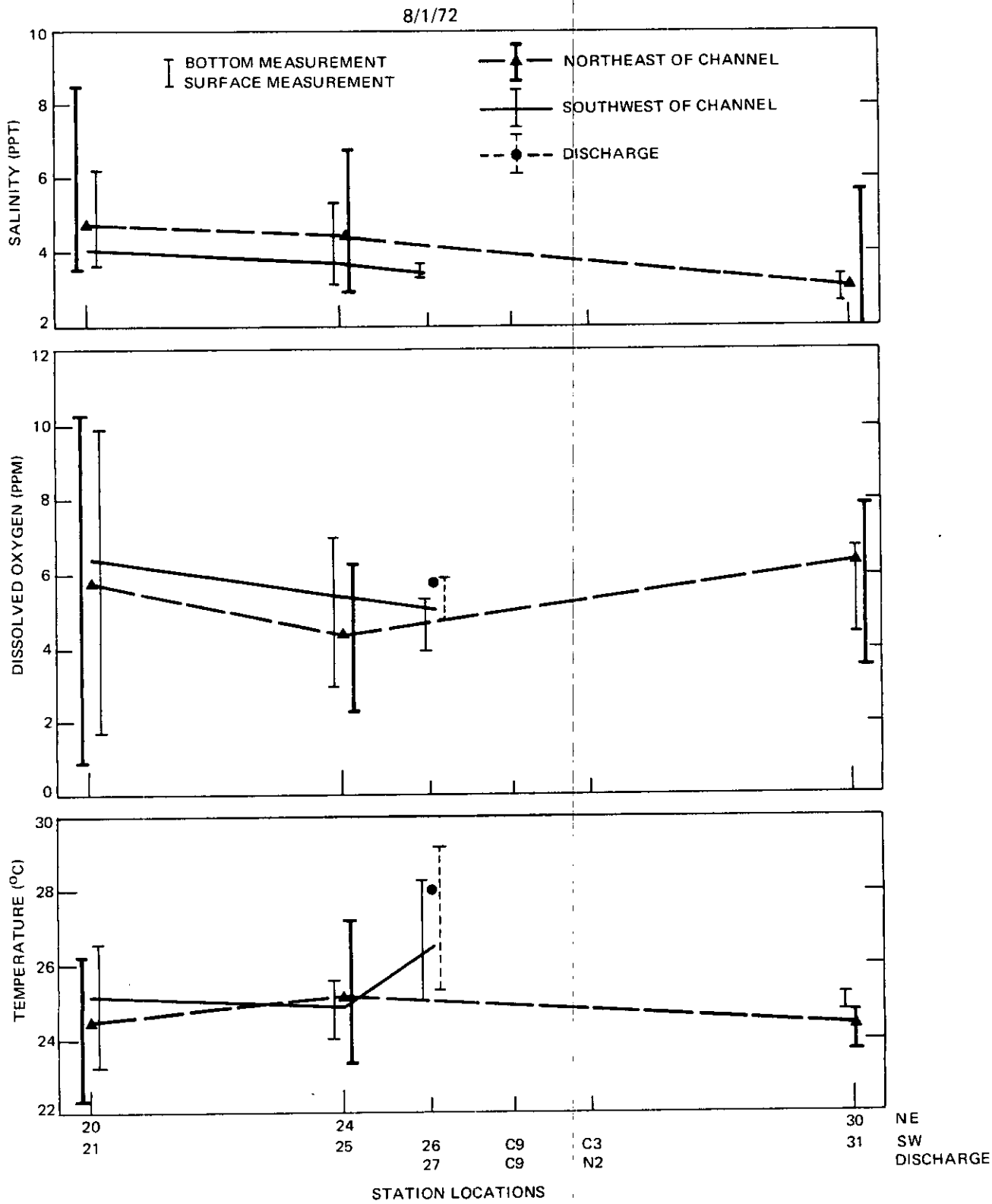
APPENDIX 3-2 Figure 3 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 5 MAY 1972.



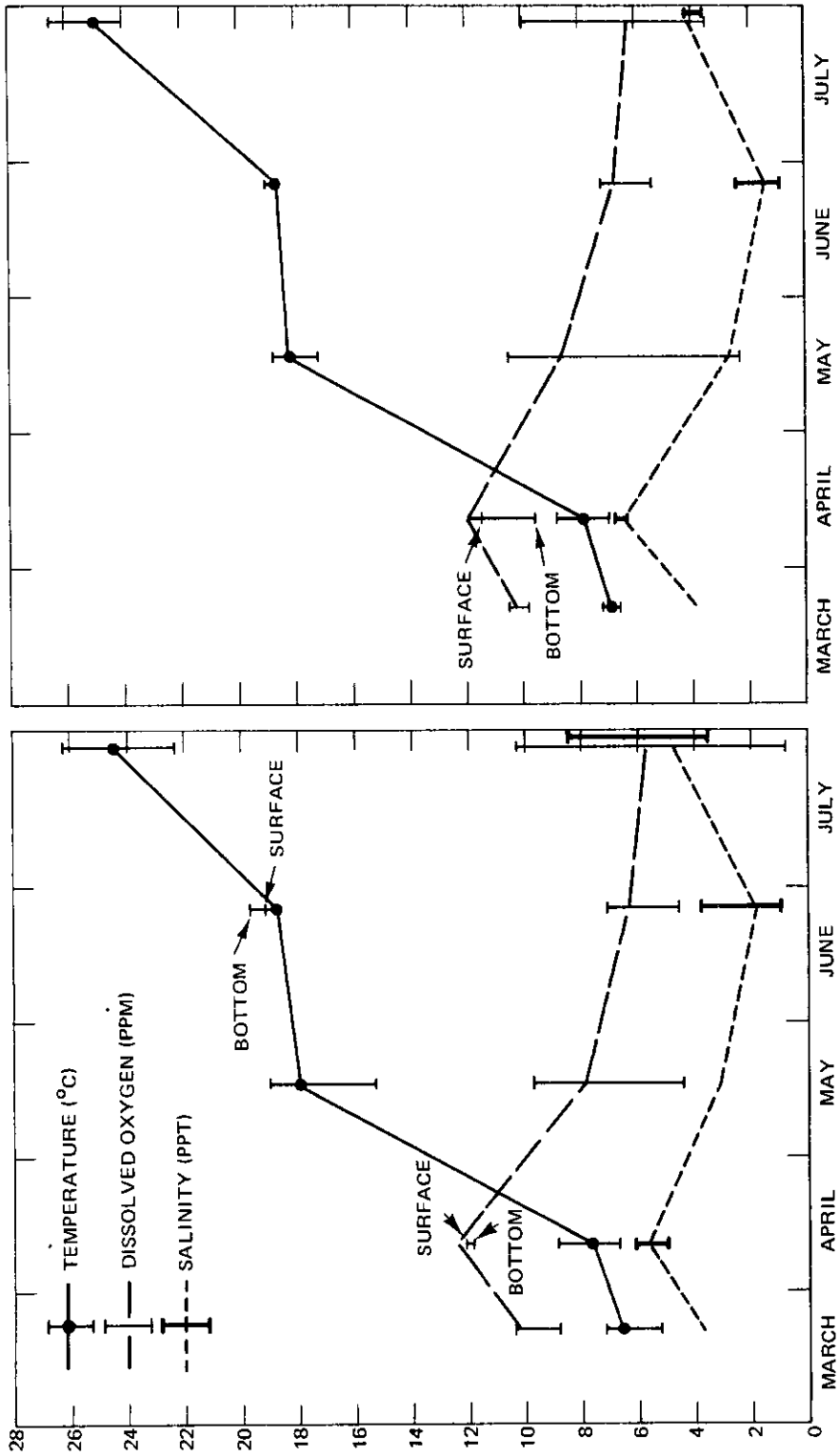
APPENDIX 3-2 Figure 4 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 17 MAY 1972



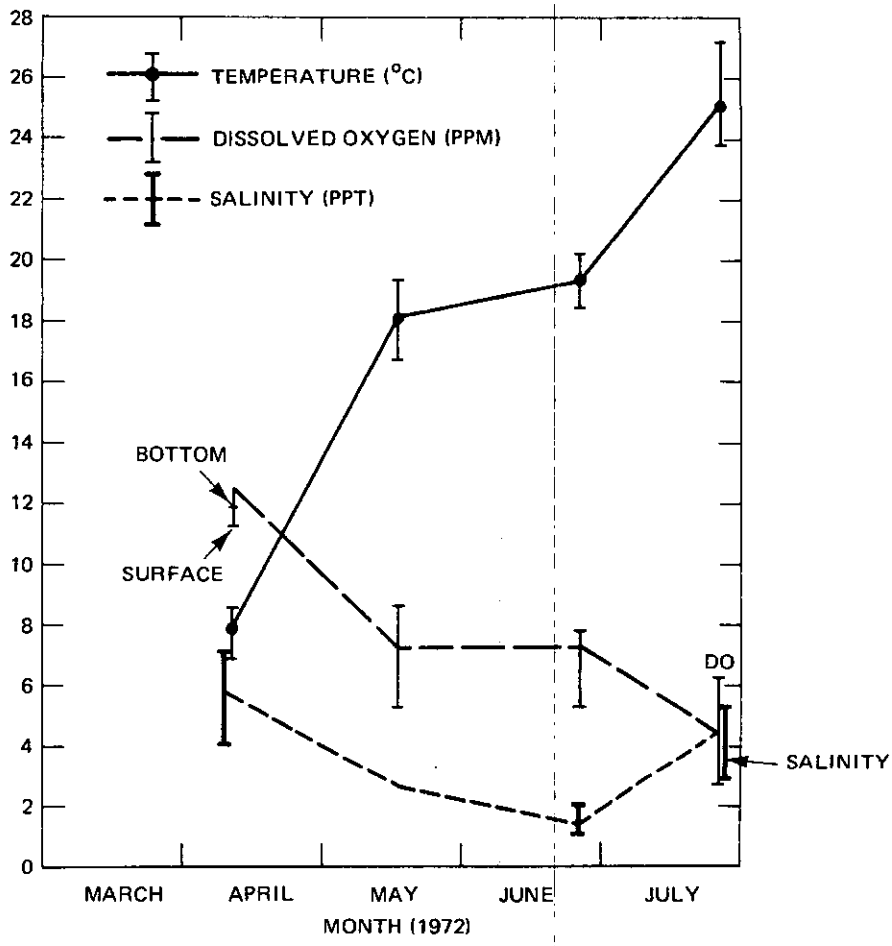
APPENDIX 3-2 Figure 5 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 26 JUNE 1972.



APPENDIX 3-2 Figure 6 SALINITY, DISSOLVED OXYGEN AND TEMPERATURE OF SAMPLING STATIONS IN THE PATAPSCO RIVER ESTUARY ON 1 AUGUST 1972

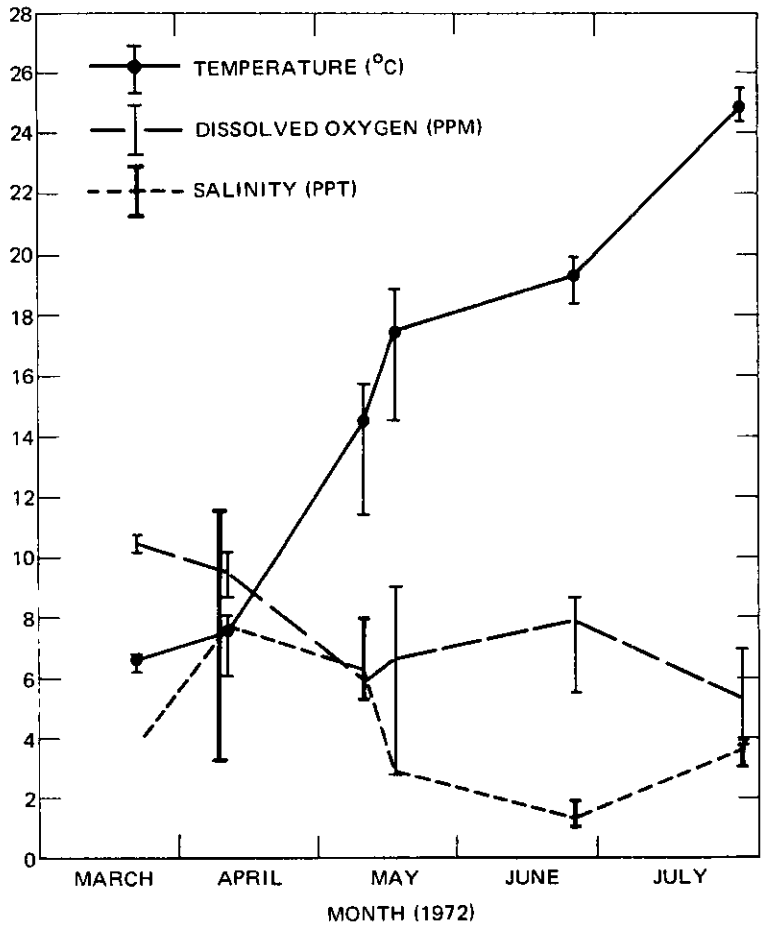


APPENDIX 3-2 Figure 7 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATIONS 20 AND 21 IN THE PATAPSCO RIVER ESTUARY.



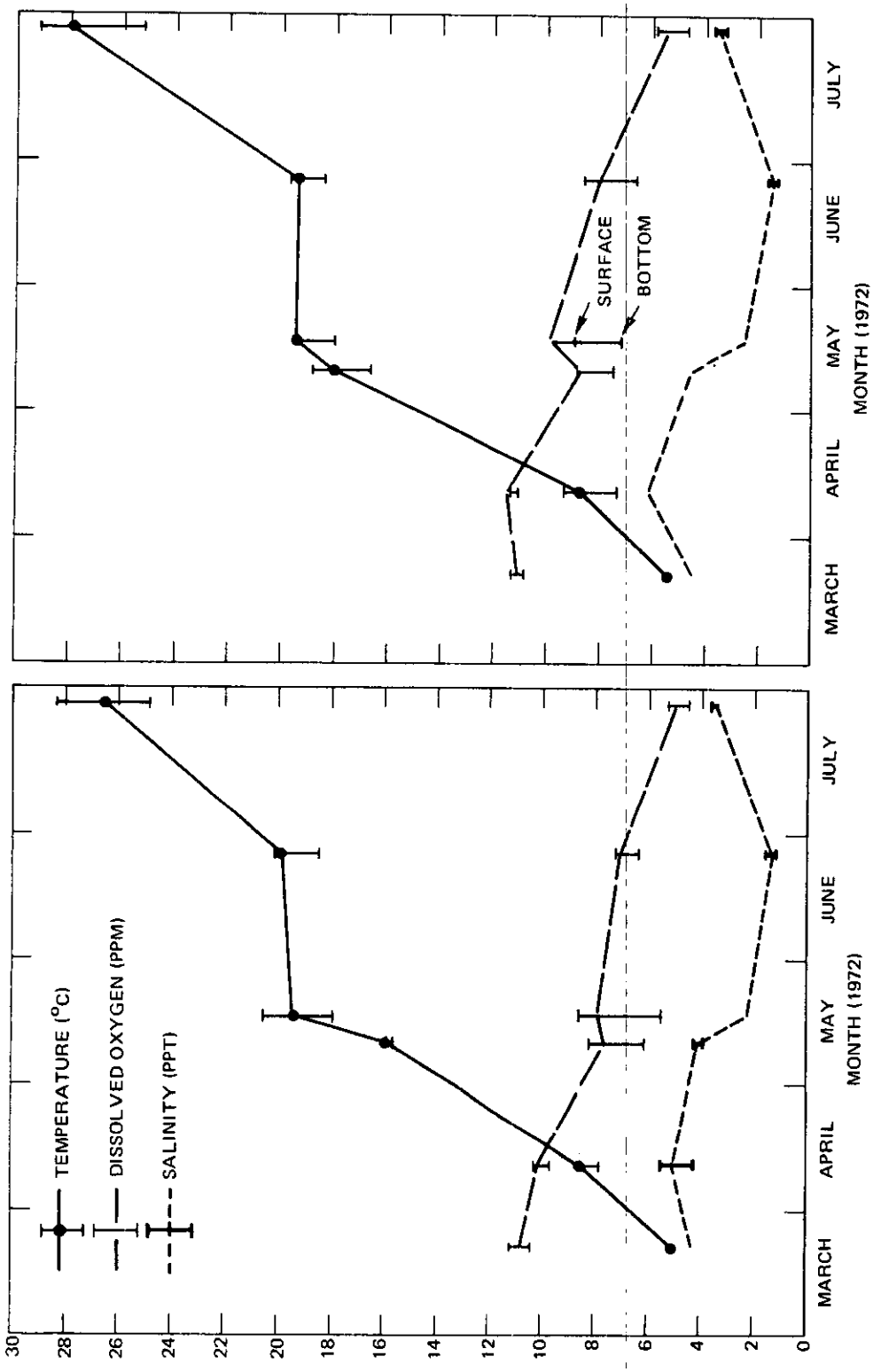
STATION 24

APPENDIX 3-2 Figure 8 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATION 24 IN THE PATAPSCO RIVER ESTUARY.

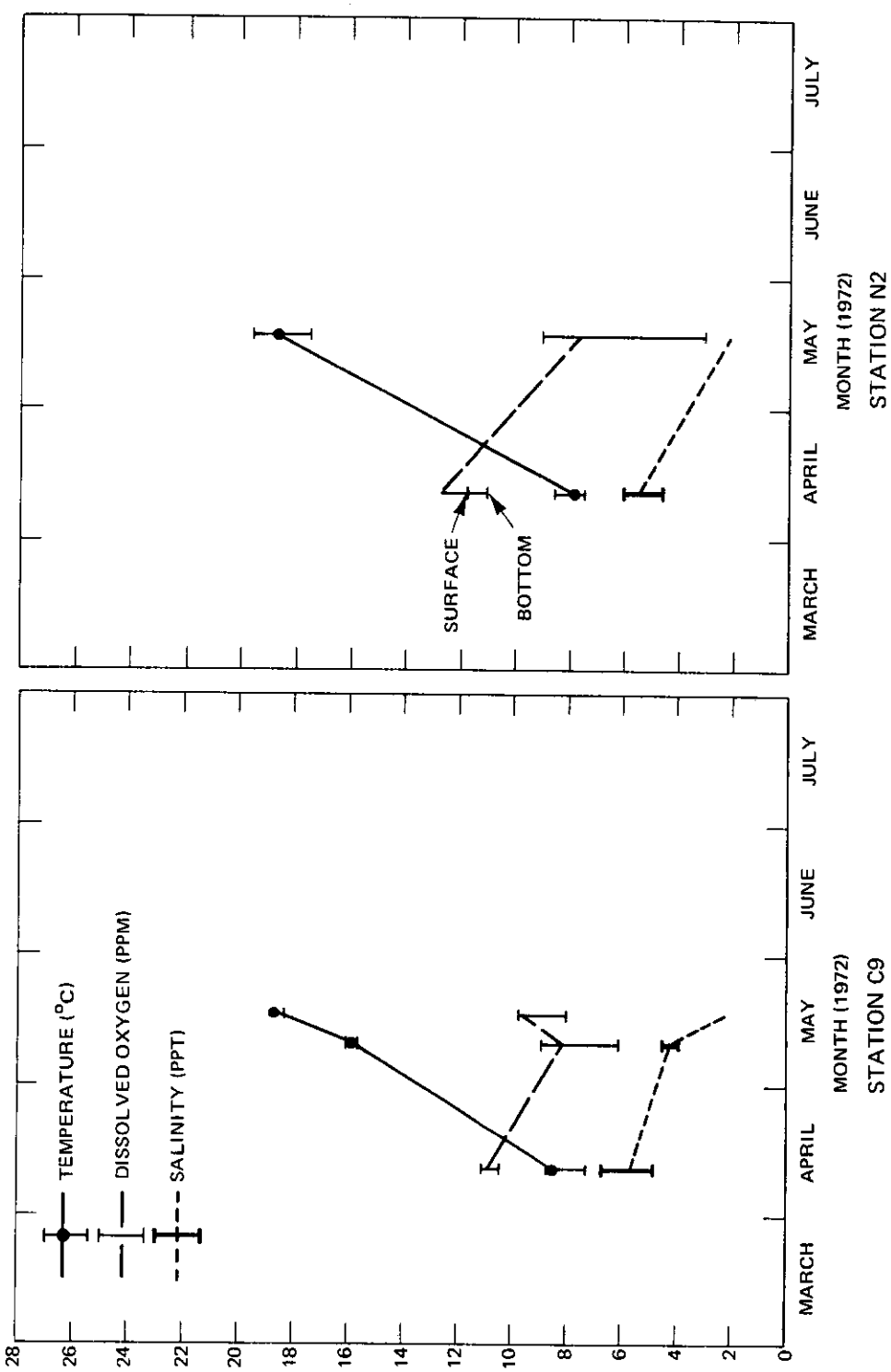


STATION 25

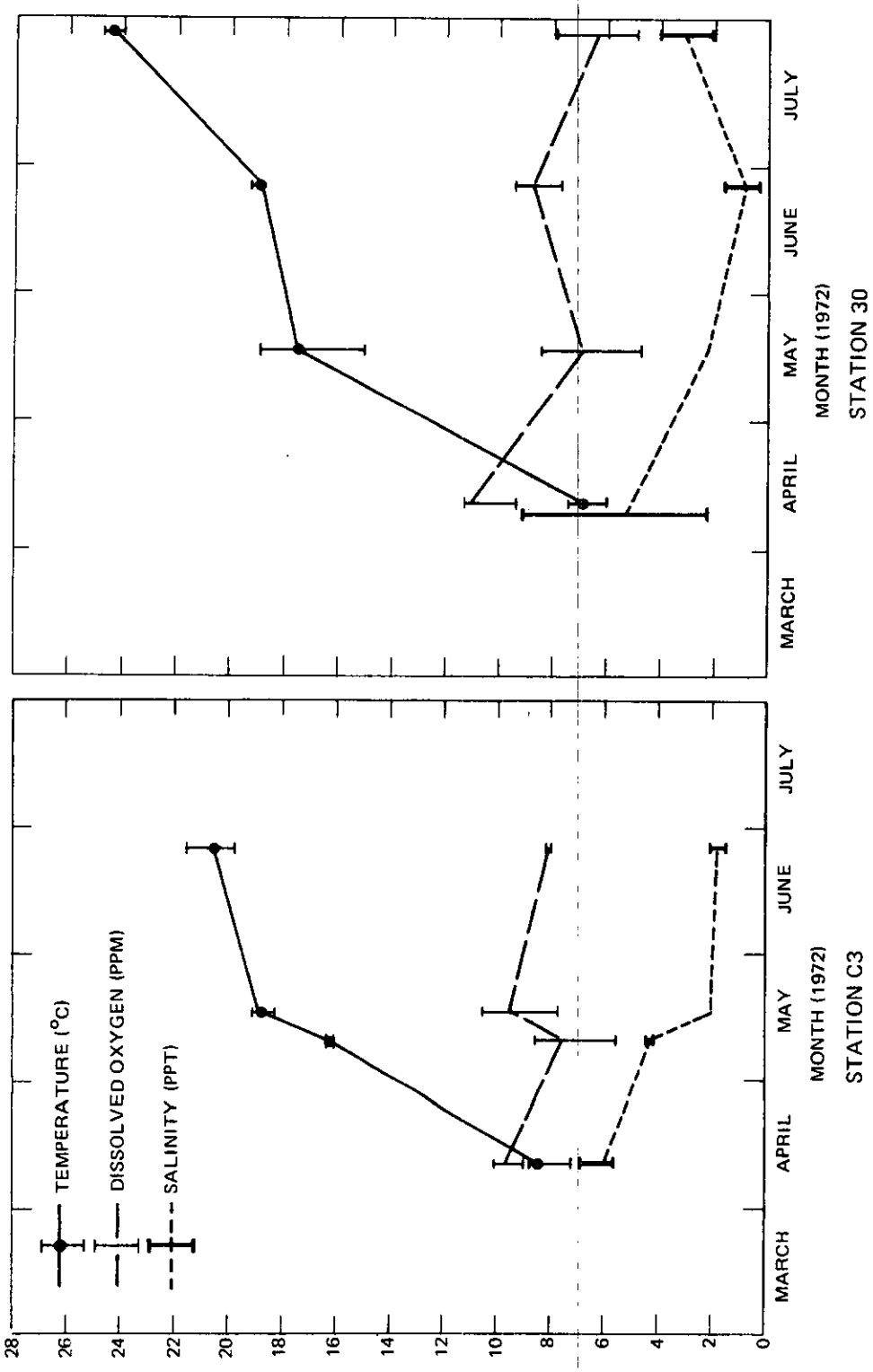
APPENDIX 3-2 Figure 9 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATION 25 IN THE PATAPSCO RIVER ESTUARY.



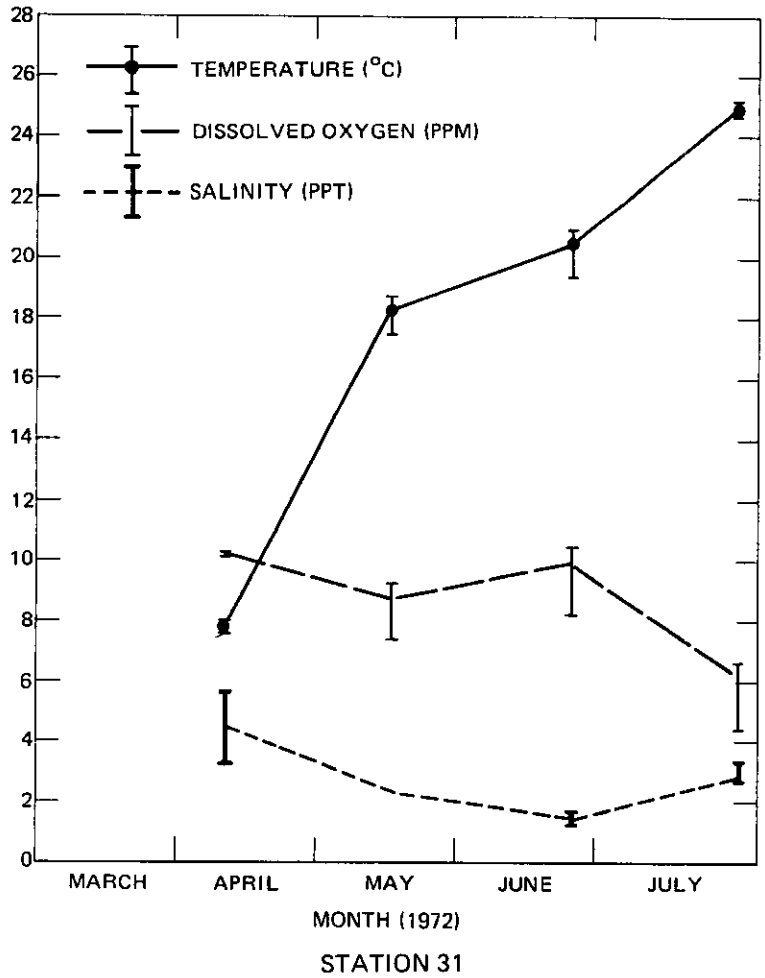
APPENDIX 3-2 Figure 10 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATIONS 26 AND 27 IN THE PATAPSCO RIVER ESTUARY.



APPENDIX 3-2 Figure 11 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATIONS C "9" AND N "2" IN THE PATAPSCO RIVER ESTUARY.



APPENDIX 3-2 Figure 12 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATIONS C "3" AND 30 IN THE PATAPSCO RIVER ESTUARY.



APPENDIX 3-2 Figure 13 SEASONAL CHANGES IN TEMPERATURE, DISSOLVED OXYGEN AND SALINITY AT STATION 31 IN THE PATAPSCO RIVER ESTUARY.

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